CHECKING VOLTAGE DROPS

Is it really that important?

Sometimes what is thought to be a battery, alternator or starter problem is actually charging system problems due to high or unwanted resistance. There’s only one method of determining if there is an adequate delivery path for optimum starting, charging, battery performance and life.

The electrical problems related to excessive voltage drops are more common than you may realize. Think of your starting and charging cables as a two-way street. The battery needs to deliver its available power to the starter through the cables and connections for cranking the engine. In turn, the alternator needs to replenish the battery and provide the power for the vehicle loads through the charging cables and connections. If the street is too narrow to carry the current, it shows up in measurable “voltage drop” or loss. This is often manifested in short battery life, frequent jump-starts or perceived alternator and starter problems.

It’s not uncommon for an alternator or starter to be replaced because it’s believed to be faulty or run its normal life cycle... only to later discover that the root cause of the problem doesn’t reside with the alternator or starter.

High or unwanted resistance is one contributing factor that leads to cranking and charging system problems. High resistance is often caused by one of these four main issues:

- Loose connections
- Corrosion in the cables and wiring
- Improperly sized wiring or cables
- Improperly crimped connectors

While a technician may regularly do a visual inspection of cables and connections it doesn’t really show what is going on inside the cables or inside the connections. This is why the concept of voltage drop testing is the only sure method of determining if there is an adequate current delivery path for optimum starting, charging, battery performance and life.

“A voltage drop test is a good ‘best practice’ during your scheduled preventative maintenance or before replacing the battery, starter or alternator,” explains Clint Stohler, Director, Technical Service and Training. “One volt drop generally equals a loss of 30 engine cranking rpms.”

Conducting a Voltage Drop Test

Equipment needed:

- Voltmeter
- Carbon pile load tester

A voltage drop test will assess voltage losses at the battery, the alternator and the starter.

Part 1: Battery

1. With the voltmeter connected to battery, and key and engine off, record a “base” voltage reading. (Your battery should have a minimum of 12.4 volts.) If it is less than 12.4 volts, charge the battery and repeat the test.
2. If the voltage is greater than 12.6 volts (AGM batteries 12.8 volts), surface charge must be removed.
3. To remove surface charge, turn on the headlights and blower motor (high speed) for one minute. Then turn off the devices and wait two minutes for the voltage to stabilize.
4. Once you have a reading that is between 12.4 and 12.6 volts you will then start the engine and bring it to normal operating temperature.
5. With the engine at 1,500 to 2,000 rpm, turn on all electrical loads (lights, blower fan, A/C, etc.). The charging voltage should be at least 0.5 volt above base voltage reading. If not, excessive resistance could be present.

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Conducting a Voltage Drop Test, continued

Part 2: Alternator Circuit with Carbon Pile (Recommended Method)

Alternator Circuit Voltage Drop Test (+) Side
Ensure the vehicle’s batteries have been tested and that the terminals have been cleaned and tightened.

1. Ensure the battery is charged to 12.4 volts minimum (AGM batteries 12.6 volts).
   - Connect the carbon pile tester positive lead to the B+ stud (output terminal) on the alternator.
   - Connect negative lead to the ground at the alternator.

2. Connect the voltmeter (set on low scale) to look for excessive resistance on the (+) side.
   - Voltmeter (+) test lead to the alternator output terminal.
   - Voltmeter (-) test lead to the battery (+) post.

3. Turn on and adjust the carbon pile to alternator-rated amperage output.
4. Read the voltmeter and record voltage. This is the positive circuit voltage loss. Immediately turn off carbon pile.

Alternator Circuit Voltage Drop Test (−) Side
1. With the carbon pile tester still connected, connect the voltmeter to the negative battery cable.
   - Voltmeter (+) test lead to the battery (-) post.
   - Voltmeter (-) test lead to the alternator ground stud or case.

2. Turn on and adjust the carbon pile to alternator-rated amperage output.
3. Read the voltmeter and record voltage. This is the negative circuit voltage loss. Immediately turn off carbon pile.

Calculating Total Circuit Voltage Drop
1. Add positive circuit loss and negative circuit loss to get total system loss. This loss shall not exceed:
   - 12-volt system: 0.500 volts maximum voltage loss
   - 24-volt system: 1.000 volts maximum voltage loss

2. Replace cables or repair circuits with excessive voltage loss.

The higher the reading in each circuit, the bigger the problem. For instance if your readings showed .2 volts loss on the positive circuit and .7 volts loss on the negative circuit, the technician needs to focus on the negative circuit.

If the voltage drop exceeds specification, check for corrosion, frayed strands of wire, loose connections or a battery cable gauge that is too small.

Part 3: Starter Circuit With Carbon Pile (Recommended Method)

Starter Circuit Voltage Drop Test (+) Side
Ensure the vehicle’s batteries have been tested and that the terminals have been cleaned and tightened.

1. Ensure the battery is charged to 12.4 volts minimum.
   - Connect the carbon pile tester positive lead to the B+ stud on the starter solenoid.
   - Connect negative lead to the ground stud on the starter.

2. Connect the voltmeter (set on low scale) to the positive battery cable.
   - Voltmeter (+) test lead to battery (+) post.
   - Voltmeter (-) test lead to starter B+ post.

3. Load the carbon pile tester to 500 amps and record voltage. This is the positive circuit voltage loss. Immediately turn off carbon pile.

Starter Circuit Voltage Drop Test (−) Side
1. With the carbon pile tester still connected, connect the voltmeter to the negative battery cable.
   - Voltmeter (+) test lead to starter ground stud or case.
   - Voltmeter (-) test lead to battery (-) post.

2. Load the carbon pile tester to 500 amps and record voltage. This is the negative circuit voltage loss. Immediately turn off carbon pile.

Calculating Total Circuit Voltage Drop
1. Add positive circuit loss and negative circuit loss to get total system loss. This loss shall not exceed:
   - 12-volt system: 0.500 volts maximum voltage loss
   - 24-volt system: 1.000 volts maximum voltage loss

2. Replace cables or repair circuits with excessive voltage loss.

If the voltage drop exceeds specification, check for corrosion, frayed strands of wire, loose connections or a battery cable gauge that is too small.